The University of Kansas
Space Technology Center

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PROGRESS REPORT
FOR
THE PERIOD MARCH-MAY 1973

FOR
SKYLAB STUDY OF WATER QUALITY
NASA CONTRACT NAS 9-13271

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TASK-347

SITES-416 + 423

PRINCIPAL INVESTIGATOR: H. L. YARGER

REPORT PREPARED BY: James R. McCauley
JAMES R. McCAULEY
RESEARCH SCIENTIST

REPORT APPROVED BY: Harold L. Yarger
HAROLD L. YARGER
PRINCIPAL INVESTIGATOR

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I. Summary of Research Objectives

Two Kansas reservoirs will be studied using Skylab data in conjunction with simultaneous ground truth information in an attempt to detect and monitor various parameters of water quality. Water samples will be collected from the reservoir or reservoirs under investigation and low-level aircraft support missions will be flown to acquire photographs which will approximate the spectral coverage of forth-coming Skylab photographs. Image analysis and data processing techniques will be developed to aid in the correlation of Skylab data with ground truth data and supporting aerial photography.

II. Work Performed During This Period

Perry and Tuttle Creek reservoirs located near Lawrence and Manhattan, Kansas respectively are of primary interest in this investigation. Sampling missions have been conducted regularly during the past 10 months on the two reservoirs. A sample site location plan has been devised that best detects the water quality variations generally present in both lakes. Approximately 10 samples have been collected from each lake. Chemical analysis has been regularly performed on these samples and the procedures and techniques used have become routine. The following analyses are performed on each sample:

a) amount of suspended solids
b) amount of dissolved solids
c) concentration of chlorophyll
d) concentration of NO_3
e) concentration of PO_4
f) concentration of K

Amount of suspended solids have been determined gravimetrically, concentration of chlorophyll by acetonic extraction and subsequent spectrophotometric measurement, and nitrate, phosphate and potassium spectrophotometrically on a Beckman DU Spectrophotometer. In addition, turbidity and water temperature have been measured at each station.

The Corps of Engineer's office at each lake provides information concerning reservoir status (inflow-outflow etc.) and weather conditions, including previous precipitation.

Study of ground truth information collected thus far has revealed that the light penetration depth is primarily controlled by suspended load. The inverse secchi depth (or 1/sunlight penetration depth) is linearly related to suspended load up to ~ 100 ppm (Figure 1). Least squares straight line fits to these data yield statistically equivalent slopes and intercepts. Although inconclusive, the few points beyond 100 ppm (not shown) indicate this linearity may hold up to 250 ppm. The greater point scatter in the Tuttle Creek data is due to higher average turbidity relative to Perry. This results in a smaller average light penetration depth and greater percent error in its measurement by the secchi disc method.

Work has also been performed developing image interpretation techniques for ERTS imagery that can be adapted to the interpretation of forthcoming Skylab photos. Work in this area has been centered around the IDECS (Image Discrimination Enhancement and Combination System) at the Center for Research, Inc. A program-controlled technique is being developed which will density slice ERTS images into levels which represent equal units of energy reflected by the water body.

Programs have also been developed for reading of computer-compatible-tapes and the generation of digital output. These programs will also be modified for use with similar Skylab data products.

Among the things found from the study of output received from ERTS CCT's concerns the ratio of the MSS 4 (green) and MSS 5 (red) density values. CCT output for lake sample stations have been used in computing the ratio between bands 4 and 5. This data for the August 13, 1972 pass over Perry reservoir has been plotted against total suspended solids and is presented in figure 2. This graph is a clear demonstration that green light penetrates water more efficiently than red (or red is absorbed more than green). The reflectance becomes similar towards higher suspended loads which is expected since very little light (green or red) is able to penetrate the water. This ratio curve does not appear to improve discrimination of suspended load levels beyond ~ 75 ppm. However, ratios of bands 4 and 5 with the infrared bands 6 and 7 appear to be more efficient in discriminating suspended load in the region beyond 75 ppm (figures 3 & 4).

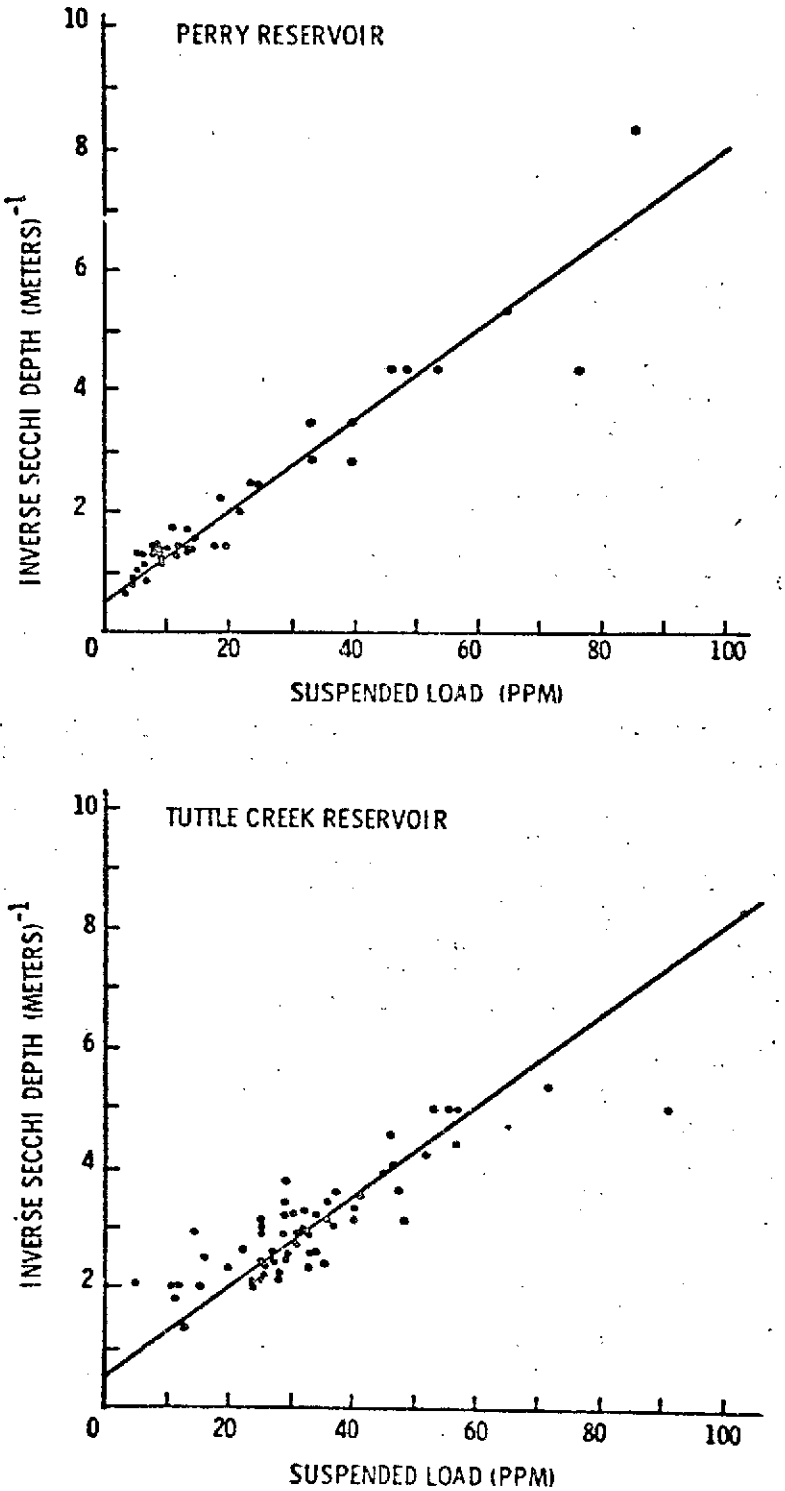

FIGURE 1. Inverse secchi depth vs. suspended load for Perry and Tuttle Creek reservoirs.

III. Conclusions

Considerable experience has been gained during the ERTS program in the collection of ground truth, it's analysis, the interpretation of imagery, and the development of data processing techniques. Much valuable information has also been acquired concerning the spectral reflectance characteristics of turbid reservoirs which will be useful for the analysis of forthcoming Skylab data.

IV. Finances

A statement of financial status for the project will be sent under separate cover by the CRINC accounting office.

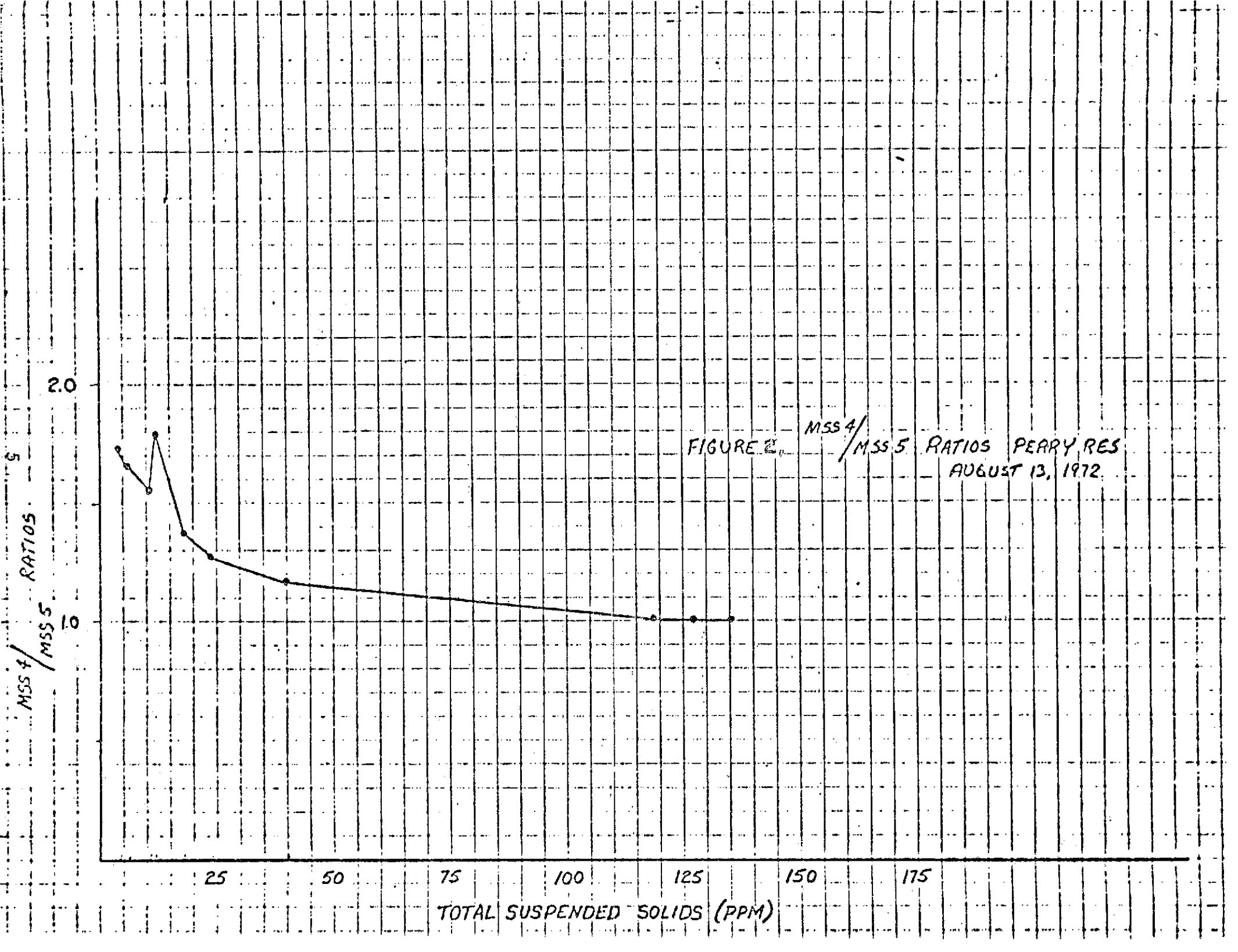

FIGURE 2. MSS 4/MSS 5 RATIOS PERRY RES
AUGUST 13, 1972

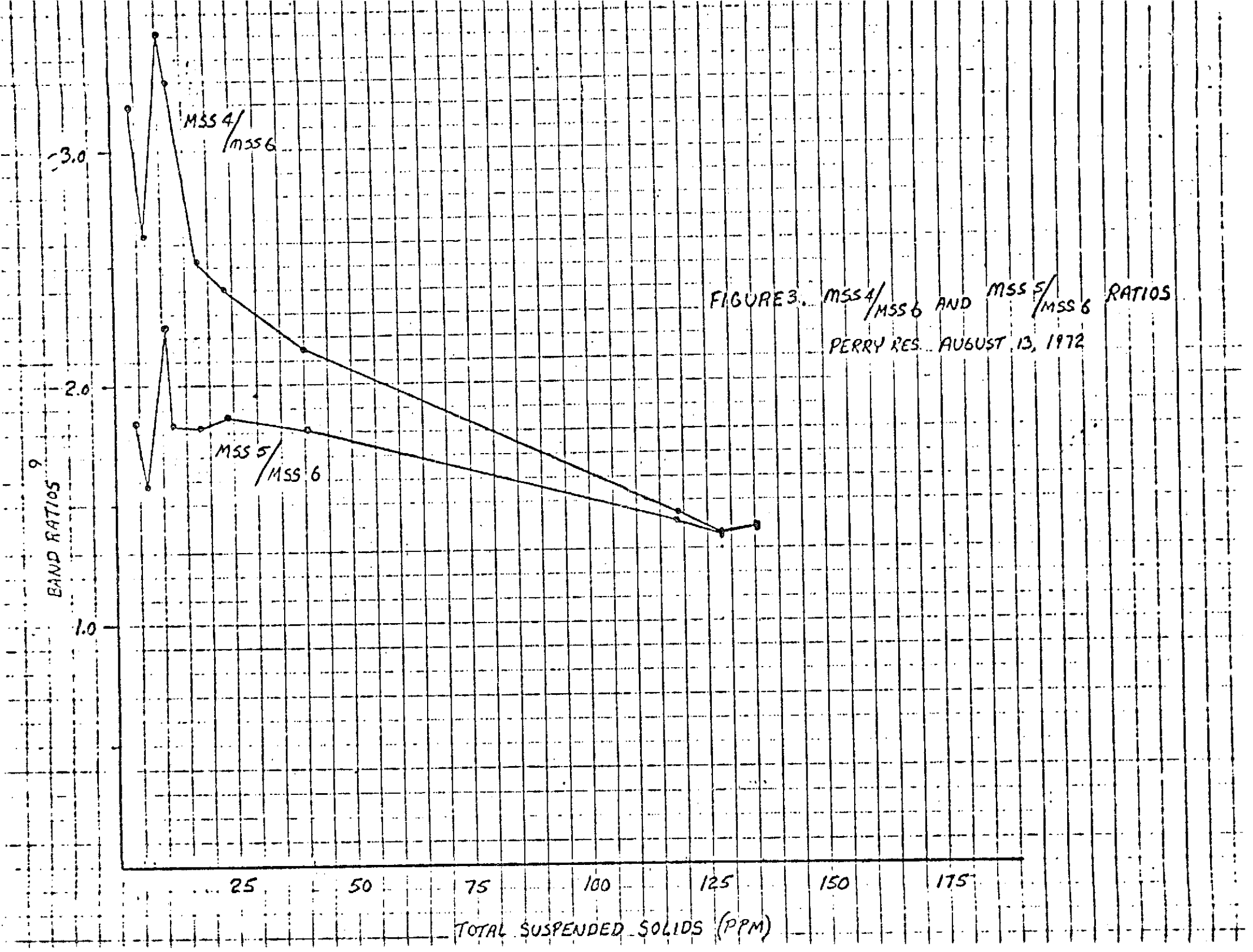

FIGURE 3. MSS 4/MSS 6 AND MSS 5/MSS 6 RATIOS
PERRY RES. AUGUST 13, 1972

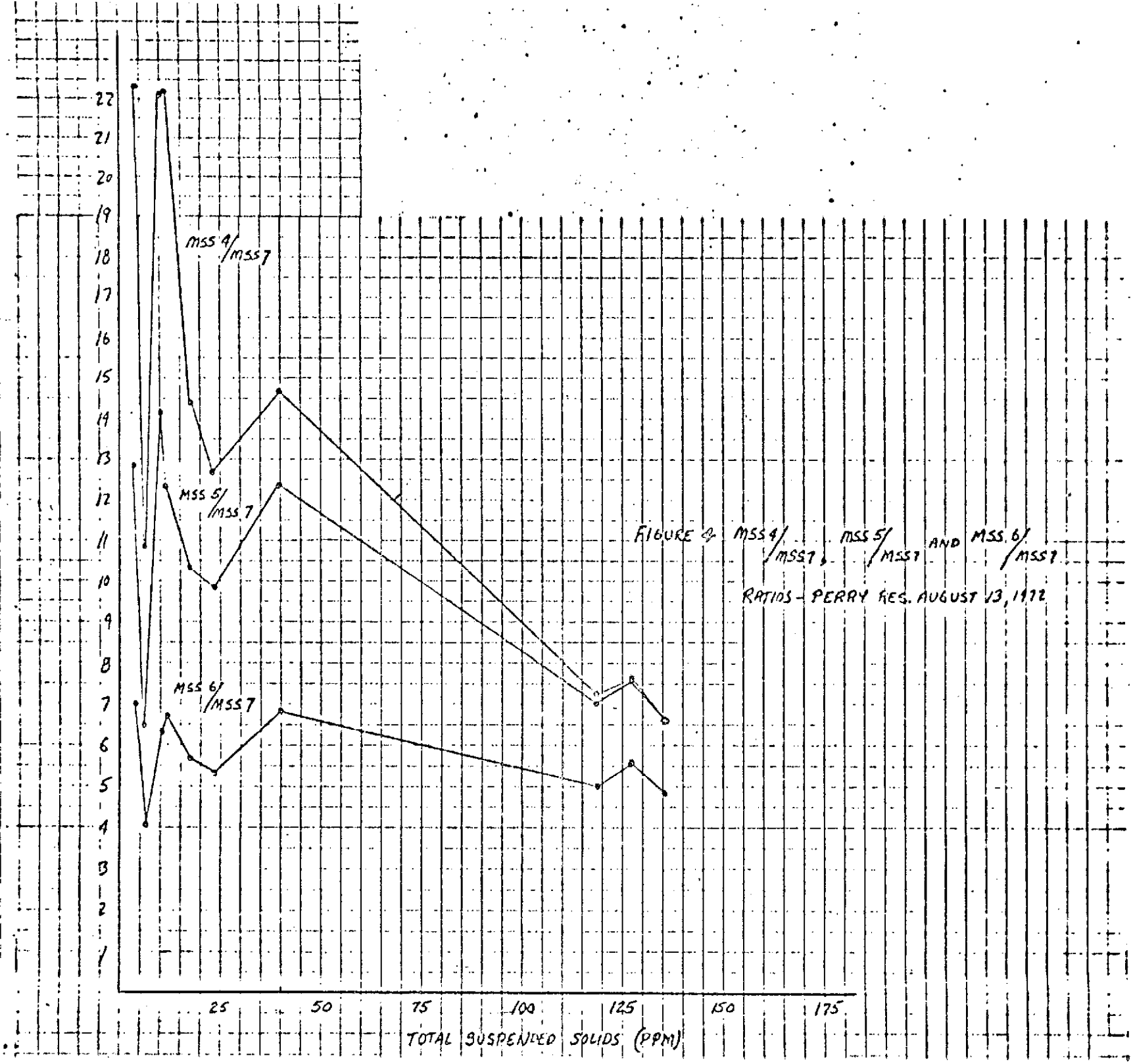

FIGURE 4 MSS 4/MSS 7, MSS 5/MSS 7 AND MSS 6/MSS 7 RATIOS - PERRY RES. AUGUST 13, 1972